Good Design = Energy Efficiency & Economy

High Performance and Sustainability on a Budget

Presented by:

Douglas R Hundley Jr PE CGD LEED AP CxA
Principal
CMTA Consulting Engineers

Steven R Ward AIA
Architect/Partner
Studio Kremer Architects

Michael Salsman
President
BCD Inc

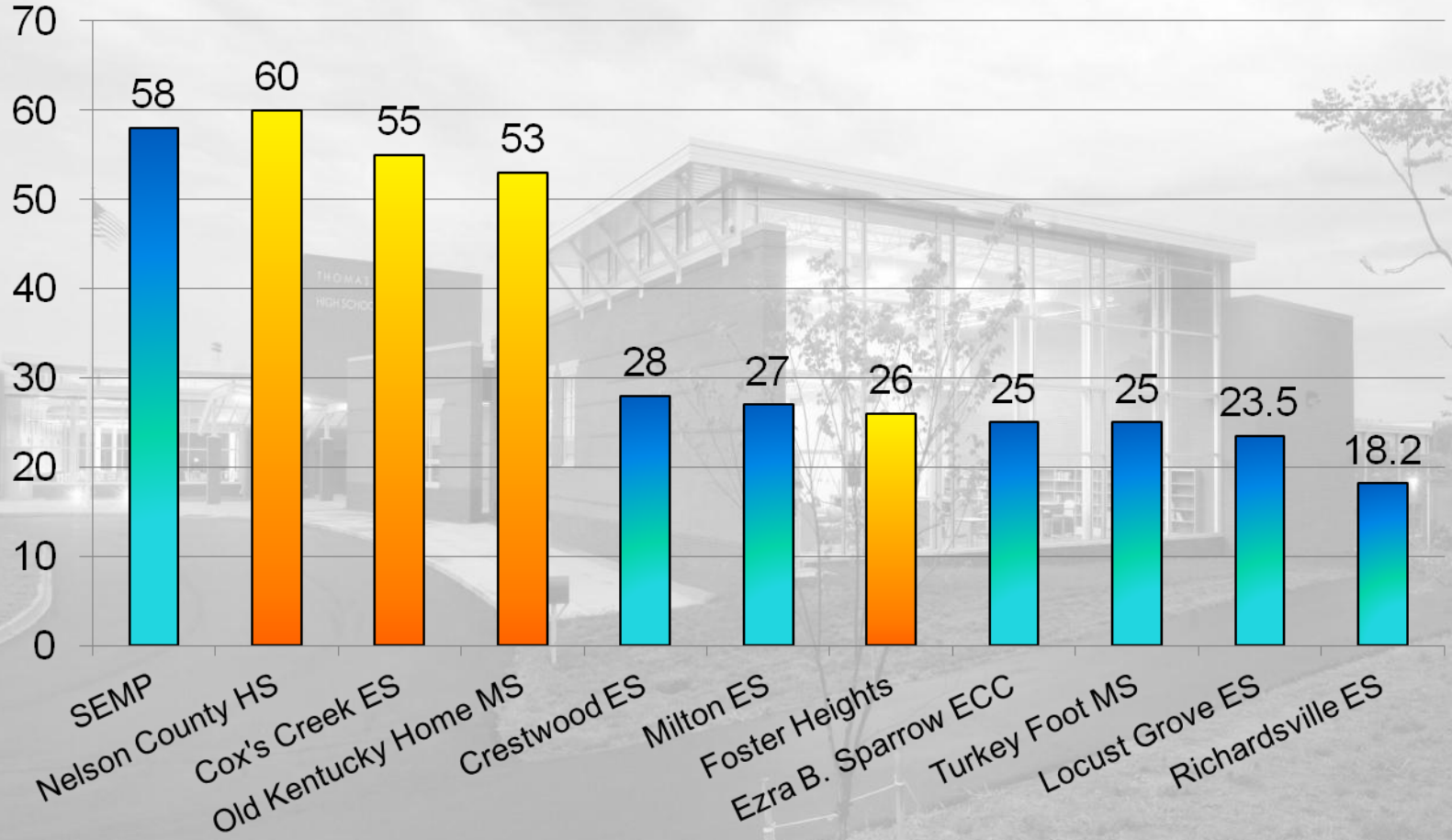
Chuck Thompson
Former Director of Facilities
Nelson County Schools

What is high performance and what is the typical cost?

Baseline Energy Usage

Buildings Energy Data Book – U.S. Department of Energy	**90 kBtu/sf yr (High School)**
ENERGY STAR Target Finder Score 50	**51 kBtu/sf yr (High School)**
School Energy Management Project	
– 2010 (Design)	**63 kBtu/sf yr (Kentucky Schools)**
– 2013 (Current)	**58 kBtu/sf yr**

How much energy does a high performance school use?



Cost

According to the “2013 Annual School Construction Report” published by *School Planning and Management*:

- Median regional (KY, NC, SC, TN) construction cost
  - High School - $189.00/sf new
- National median construction cost
  - High School - $214.37/sf new

Case Study 2:

- The design team worked closely over several months with the committee of 20-30 faculty, staff, administrators, parents and community members that Superintendent convened
- Goal was to ensure that the design communicated that the school is part of the **larger community**

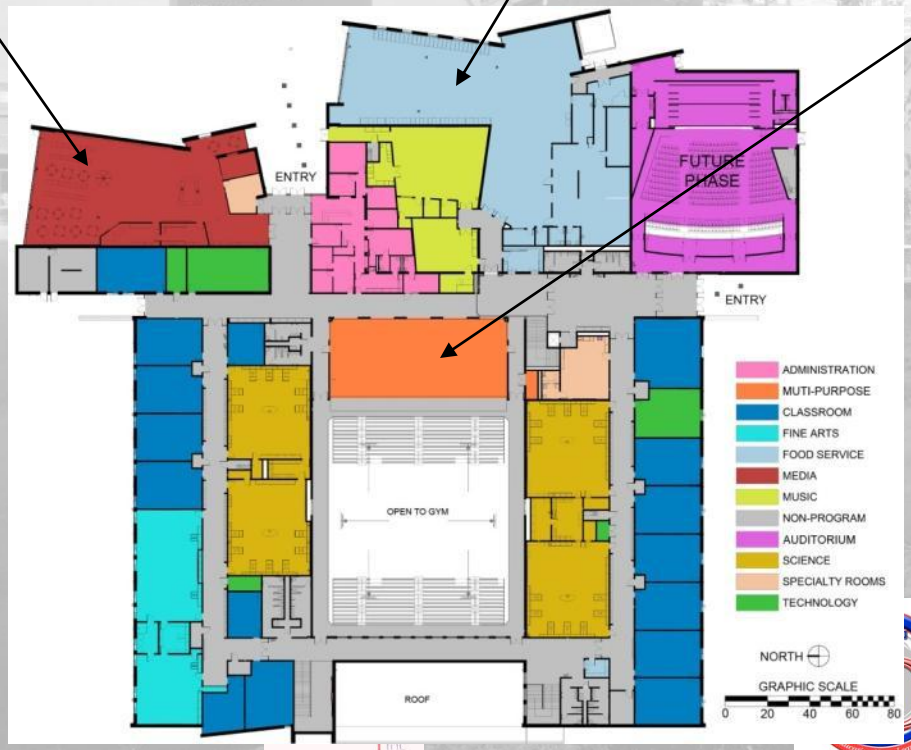
- **Material selections and forms complement the surrounding landscape**
- **The architects studied elements of buildings in the historic downtown**

- A school is such a big investment that it needs to become a community landmark and anchor, serving the whole community over a long period of time.
- 'Green' thinking, for this design team, was an integral part of a holistic effort to design a project that is efficiently planned, economical to operate and, most importantly…that engages its community and users in a way that they will want to be its stewards for decades to come.
- **The process starts with integrated thinking from the whole team from the beginning.**

- Space-planning was pursued to maximize efficiency and connectivity of circulation (i.e., no ‘dead ends’).
- Public spaces were configured in order to provide maximum flexibility in how they could be used:

Media Center: Except for the lecture area where fixed data/power is provided, the space is designed to be adaptable to suit evolving uses and technologies.

Cafeteria: Choices of seating type/spatial character – booth, café, group tables – were provided. Accommodation for future serving options (e.g., kiosk or food court style) was provided.



Multi-Purpose Room: unassigned space can be:
1) closed for activities (cheering, wrestling, ROTC…),

2) opened to main hall to expand public space, or

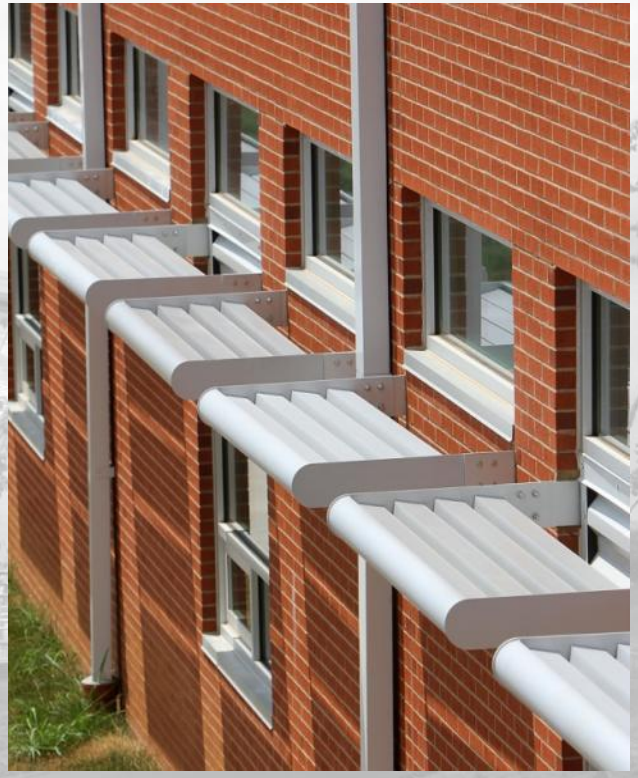
3) used as expansion for the Gym when the upper bleachers are opened.

- Nelson County Schools' commitment to geothermal HVAC
- There is a single unit per pair of classrooms
- Each bore (or well) was installed to a depth of 400 feet
- The whole well field is made up of 162 of these 400' deep bores.

Geothermal and hydronic piping at the water-to-water heat pumps utilized to generate hot and chilled water for the dedicated outdoor air units (DOAS).

- This project utilized Insulated Concrete Forms (ICF), a system that consists of rigid forms set in place and filled with concrete.
- This increased wall insulation and decreased air infiltration
- Allowing the engineers to reduce the sizes of HVAC system

- An aggressive daylighting strategy was implemented in order to welcome as much natural light into the building as possible
- Lessened the need for electrical lighting and mitigated the temperature increase they cause
- Because of these strategies we were able to use fewer light fixtures, smaller HVAC equipment, and lights can be off or dimmed a large percentage of the time.



Large window openings to the north allow as much light to enter these spaces as possible

- North light doesn't produce significant glare
- Electrical lights dimmed 35% or off

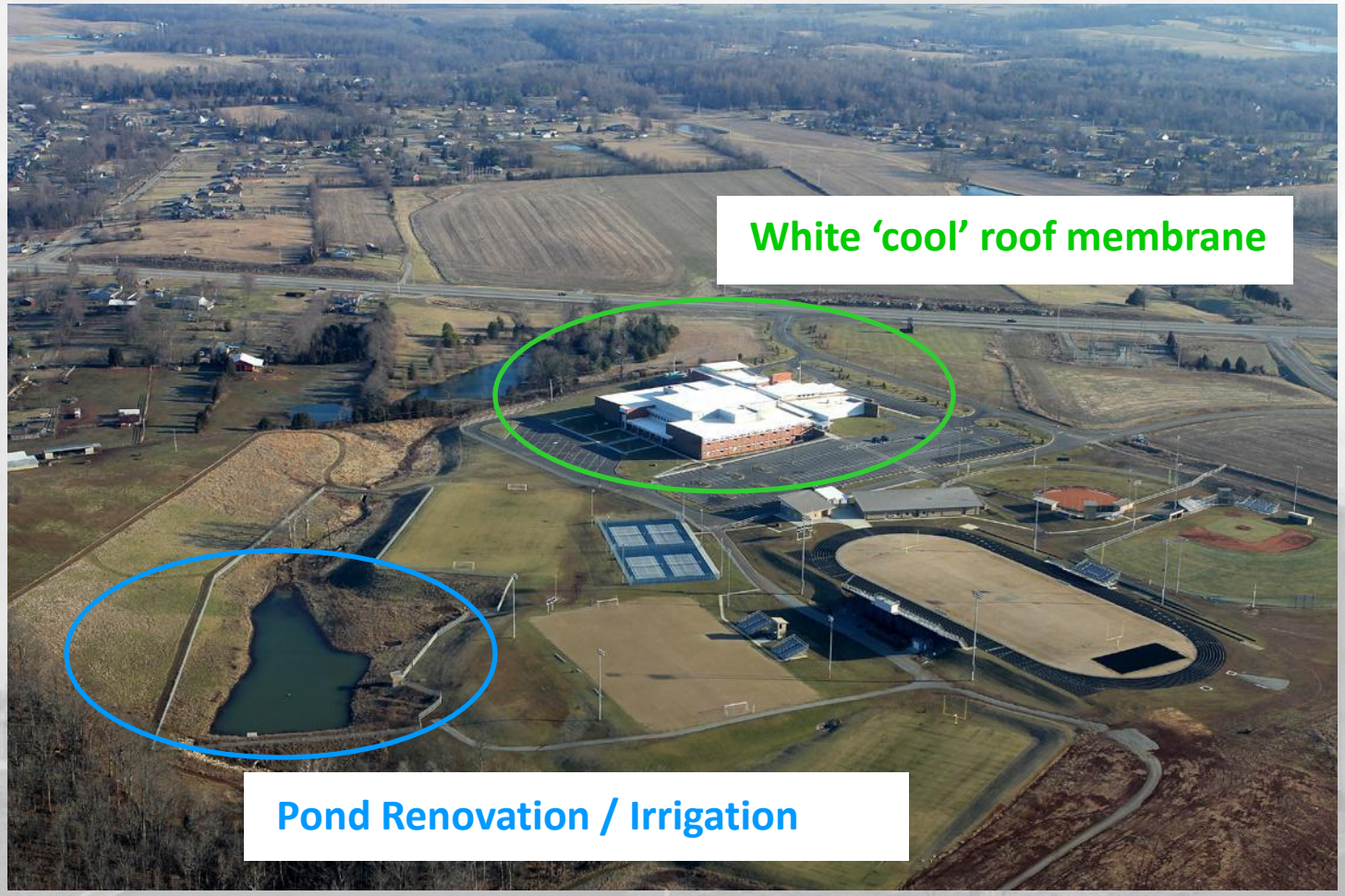
Smaller, controlled windows to the south direct light into the rooms up at the ceiling

- Ceilings are sloped
- Aluminum light shelves reflect light
- Electrical lights off or dimmed 75% of the time

Lights will automatically dim to conserve energy

Most lights in the building are on occupancy sensors

High / Clerestory windows at the Media Center, Cafeteria, Field House, and Gym allow natural daylighting into these spaces, reducing the need for interior lighting


White ‘cool’ roof membrane
Pond Renovation / Irrigation

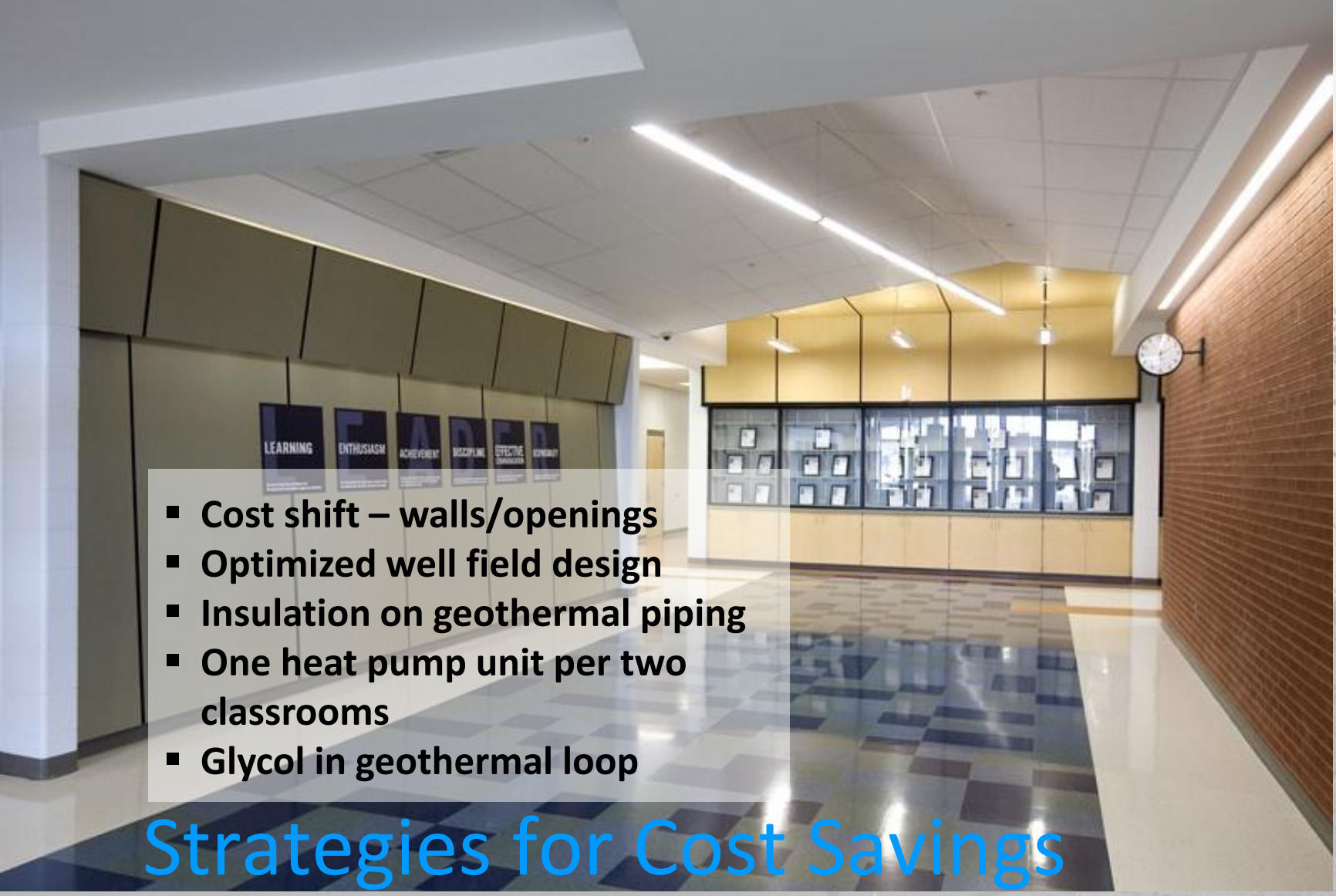
Big Picture

- 146,000 square feet
- $23,557,000
- $150/sf including field house (10K sf), fields, and other site development
- Actual 2013 EUI 21.8
- Annual energy cost: $101,164 or $0.69/sf

- Field house and playing fields are separately metered
  - Actual 2013 EUI 54
  - $1.56/sf annual energy cost

Strategies for Energy Savings

- Two story compact design
- North/South Classroom Wings
- Geothermal HVAC with DOAS
- Energy efficient lighting
- Daylighting – ROI analysis
- Optimized controls
- White roof
- Geothermal domestic hot water
- ICF Wall Construction – first cost analysis



- Cost shift – walls/openings
- Optimized well field design
- Insulation on geothermal piping
- One heat pump unit per two classrooms
- Glycol in geothermal loop

Strategies for Cost Savings

Lessons Learned

- Geothermal piping temperatures at start-up
- Reconsider use of VRV

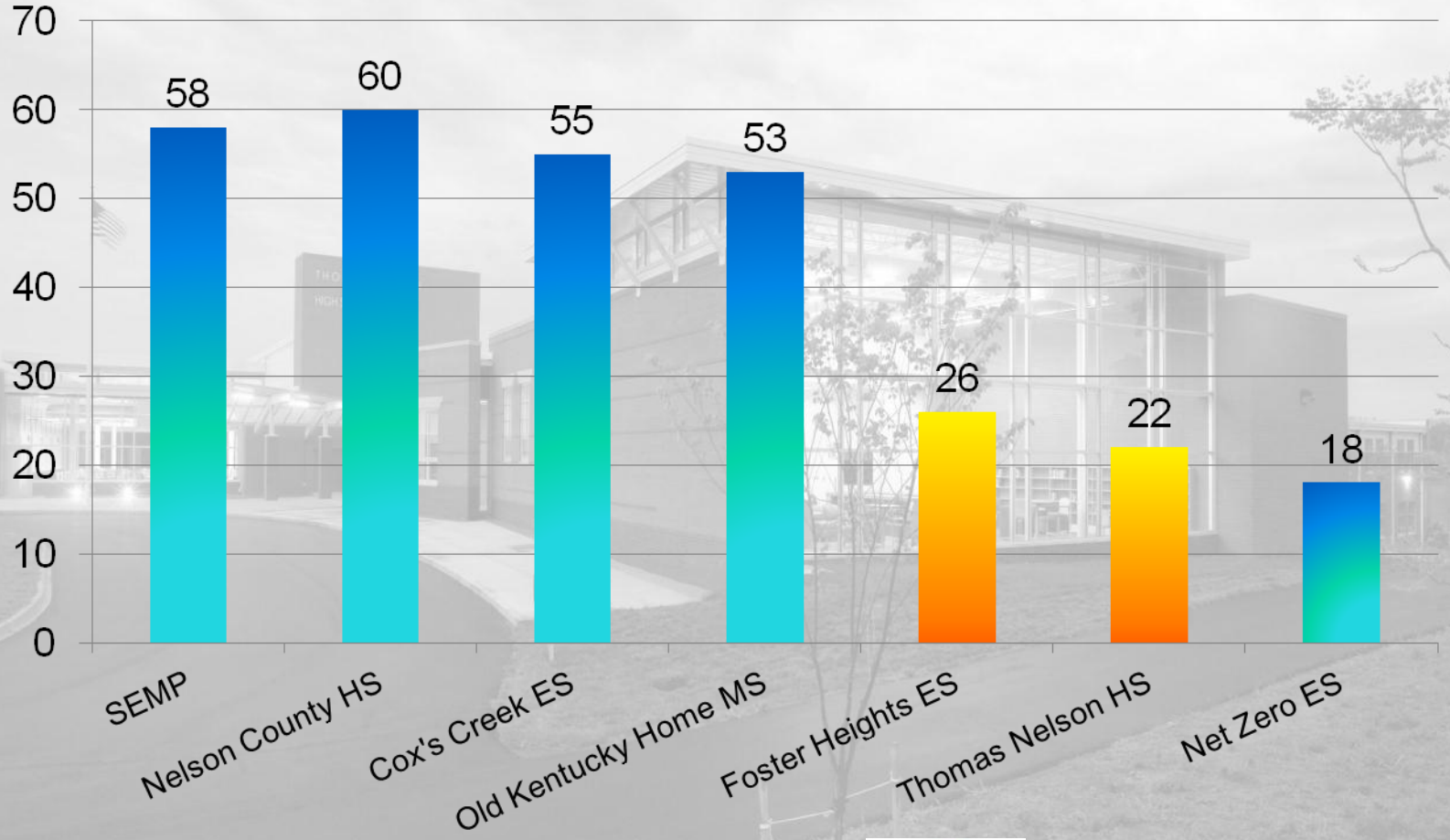
Savings

Construction Costs		
Thomas Nelson High School (156,000 sf)	$23,557,000	
National Median High School (156,000 sf)	$33,442,000	($9,885,000)
Regional Median High School (156,000 sf)	$29,484,000	($5,927,000)

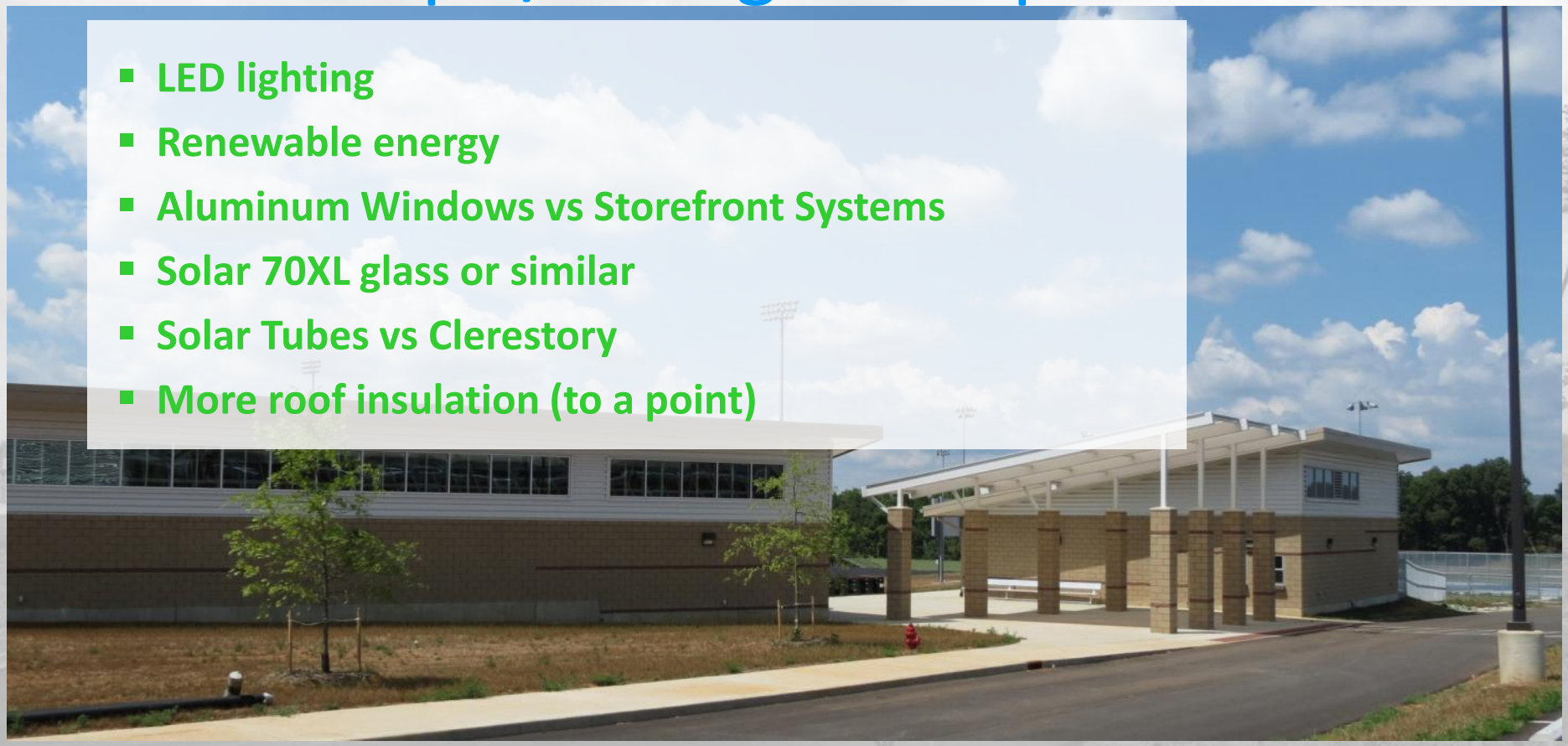
Savings

Annual Energy Costs		
Thomas Nelson High School (22 kBtu/sf yr)	$101,000	
Regional Median High School (90 kBtu/sf yr)	$420,000	($319,000)
Average Kentucky School, 2013 (58 kBtu/sf yr)	$260,000	($159,000)
Average Teacher's Salary in Kentucky	$50,000	Energy savings = 3+ teacher salaries (annually)

How much energy does a high performance school use?



Next Steps / Things to Explore



- LED lighting
- Renewable energy
- Aluminum Windows vs Storefront Systems
- Solar 70XL glass or similar
- Solar Tubes vs Clerestory
- More roof insulation (to a point)

Good Design

= Energy Efficiency & Economy

High Performance and Sustainability on a Budget

Questions?

Presented by:

Douglas R Hundley Jr PE CGD LEED AP CxA
Principal
CMTA Consulting Engineers

Steven R Ward AIA
Architect/Partner
Studio Kremer Architects

Michael Salsman
President
BCD Inc

Chuck Thompson
Former Director of Facilities
Nelson County Schools